PixeLINK

MAKING DIGITAL IMAGING SIMPLE

Megapixel FireWire Camera System Guide

PL-A630 to PL-A660 Series Cameras

Imaging Modules

Cameras

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PixeLINK™ Megapixel FireWire Camera System Guide

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PL-A630 to PL-A660 Series Cameras

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1

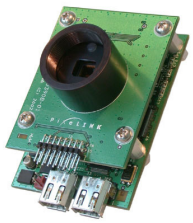
Introduction

1.1 The PixeLINK Megapixel FireWire Camera

PixeLINK 1.3 Megapixel FireWire (IEEE 1394) Cameras offer a fast and affordable means of viewing and capturing high quality color images on a desktop or laptop computer. The cameras are connected to a host computer by a single FireWire interface and all camera functions are controlled by the computer. PixeLINK supplies host software consisting of drivers and application software called *PixeLINK Capture*. An Applications Programming Interface (API) compatible with C/C++ and Visual Basic along with LabVIEW API function wrappers is also available. The driver supports Direct Show and *PixeLINK Capture* provides a TWAIN interface for use with third party applications.

Table 1.1 PixeLINK Megapixel FireWire Camera Models

Cameras	Camera Type	
	Color	Monochrome
PL-A661		✓
PL-A662	✓	
PL-A641		✓
PL-A642	✓	



Imaging Modules	Camera Type		
	Color	Monochrome	Enhanced Control
PL-A653		✓	✓
PL-A654	✓		✓
PL-A631		✓	
PL-A632	✓		
PL-A633		✓	✓
PL-A634	✓		✓

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1.2 Topics Covered in this Guide

This Guide provides a reference for the PixeLINK camera hardware, firmware and system software for the camera models listed in Table 1.1 above.

Users should consult this Guide …

… before using the Enhanced Control header on a PixeLINK Imaging Module

… as a guide for mounting a camera within a system or enclosure

… to gain a basic understanding of the relationship between the camera and the operating system

Sections include:

- A description of the camera hardware—Section 2
- An overview of selected host software and architecture (Microsoft Windows)—Section 3
- Notes about exposure methods—Section 4

References in the PDF version of this Guide are hyperlinked for easy navigation and access.

Refer to your PixeLINK Camera User's Manual for information on

- Camera software installation
- *PixeLINK Capture*
- TWAIN (Microsoft Windows) or QuickTime (Mac OS X)

1.3 System Requirements

1.3.1 Windows

One of the following Microsoft Windows operating systems must be installed:

- Windows 98 Second Edition (SE)
- Windows 2000, with Service Pack 1 (SP1) installed
- Windows XP, with Service Pack 1 (SP1) installed

Service Packs are available for download from the Microsoft Web Site, http://www.microsoft.com/

Hardware requirements:

- Microprocessor:
  Recommended—Pentium® 4 or equivalent, 1.5 GHz
  Minimum—Pentium® III or equivalent, 450 MHz
- Memory:
  Recommended—128 MB RAM
  Minimum—64 MB RAM

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- Desktop resolution:
  Recommended—1280 × 1024
  Minimum—VGA (640 × 480)
- 30 MB of hard drive space
- A video card with 24-bit or 32-bit True Color graphics capability, at least 8 MB of video memory and the latest vendor driver installed
- **Desktops:** A preinstalled FireWire PCI card or a built-in FireWire port. PixeLINK supplies a compatible PCI FireWire card with it's camera and developer kits.
- **Laptops:** A preinstalled FireWire Cardbus card or a built-in FireWire port

1.3.2 Macintosh

The PixeLINK Camera software is designed to work on a Macintosh platform running Mac OS X.

Additional Software

The most recent versions of FireWire and QuickTime are available for download on the Apple Web site (http://developer.apple.com/quicktime/).

Additional Hardware

A FireWire (IEEE 1394) port (standard on most Mac platforms):

- Built-in—B&W G3, Power Books, G4 Power Macs, iMacs, iBooks
- CardBus FireWire Card (laptop computers)
- Third Party OHCI or LYNX PCI FireWire Card

1.3.3 Laptop Computers

Because of the specialized hardware configurations of laptop computers, they require additional installation considerations:

- **An external 12 V DC power supply**—Check the connectors on the FireWire Cardbus card or built-in FireWire port. If the connectors have six pins, the FireWire cable may be able to supply the necessary power to the camera (refer to the computer's documentation for confirmation). If the connectors have four pins, the Camera will need an external power supply.

PixeLINK provides accessory kits for both FireWire enabled laptops (product number PL-1394-LAPTOP-ACC) and laptops without FireWire ports (product number PL-LAPTOP-ACC). Please contact your local PixeLINK dealer for more information.

1.4 Camera Accessories

Accessories such as tripod mounts, lenses, laptop accessory kits and hands-free switches are available from PixeLINK. For a current list of accessories, visit the PixeLINK Web site at http://www.pixelink.com/ or contact your PixeLINK vendor.

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1.5 The PixeLINK Camera Application Programming Interface

The PixeLINK Camera Application Programming Interface (API) offers application software developers a means to adapt existing programs or develop new imaging applications for PixeLINK cameras. The API is designed to simplify the most common tasks associated with configuring and controlling the cameras. Applications can also leverage the advanced command and control capabilities to enable enhanced functions via available I²C or general purpose I/O connectors.

The PixeLINK Camera API software and reference documentation are available as Software Developer's Kits (SDK) and are included in PixeLINK Camera Developer's Kits.

1.6 Compatibility with Other PixeLINK Camera Products

PL-A630 to PL-A660 Series cameras are compatible with PixeLINK software from Release 3.2 and earlier. Cameras with version numbers less than 3.0 will not function with Release 3.2 software on a Mac OS X operating system.

1.7 Related PixeLINK Documentation

- **PixeLINK Megapixel FireWire Camera User's Manual, Release 3.2**

  This manual describes the functionality of the PixeLINK Megapixel FireWire camera hardware and software, including *PixeLINK Capture.*

  Users should consult the User's Manual

  … before installing the camera hardware or software
  … as a guide when using *PixeLINK Capture*
  … for tips on using the camera with TWAIN-enabled (Windows)

  Sections include:

  - Installation of the camera hardware and software
  - Basic features of the camera hardware
  - Features and operation of *PixeLINK Capture*
  - An overview of TWAIN (Windows)

- **PixeLINK Megapixel FireWire Camera User's Manual – Mac OS X, Release 3.2**

  This manual describes the functionality of the Mac OS X version of *PixeLINK Capture.*

  Users should consult the User's Manual

  … before installing the camera hardware or software
  … as a guide when using the Mac OS X version of *PixeLINK Capture*
  … as a guide when using QuickTime-enabled third-party software.

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Sections include:

- Installation of the camera hardware and software
- Basic features of the camera hardware
- Features and operation of the Mac OS X version of *PixeLINK Capture*
- Using PixeLINK Cameras with QuickTime Video Panels.

- **PixeLINK Megapixel FireWire Camera API Reference, Release 3.2**

  [Applies to Microsoft Windows only] This manual provides a reference for the PixeLINK Camera API and related software.

  Sections include:

  - Basic principles of using the PixeLINK Camera API
  - A summary of the PixeLINK Camera API functions
  - Descriptions of individual API functions

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2

Hardware Overview

2.1 PL-A6xx Camera Features

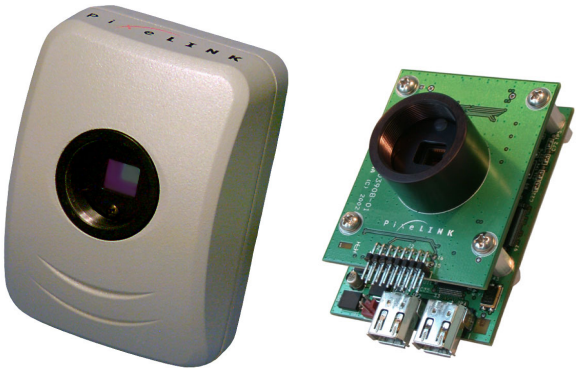

Figure 2.1 PL-A6xx Cameras

Camera Features:

- 1.3 Megapixel imager resolution (1280 × 1024)
- 8/10-bit RGB (color) or monochrome pixels
- Integrated infra-red (IR) filter over the image sensor
- Two FireWire connectors
- Lens mount for a standard C-mount lens (1" × 32 tpi)
- Mounting holes for a tripod or other mounting fixture (4–40 screws)

2.2 PL-A640 and PL-A660 Series Camera Hardware

The PL-A640 and PL-A660 cameras are enclosed in an aluminum housing. The cameras have two FireWire ports, both identical, and a C-mount lens adapter with a removeable infra-red (IR) filter. Three mounting holes are provided in the rear of the unit for mounting to a fixture or the compatible PixeLINK 1/4-20 mount accessory. See Figure 2.2 and Figure 2.3 (on page 7) for locations of hardware features.

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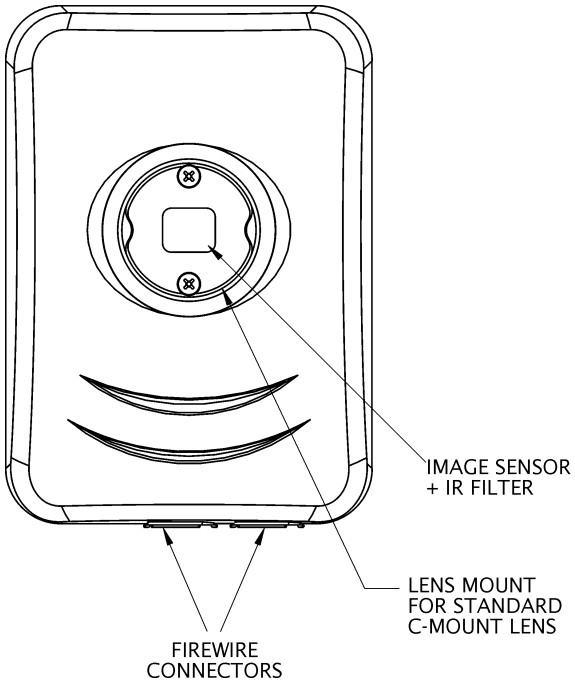

Figure 2.2 Camera Features, Top View

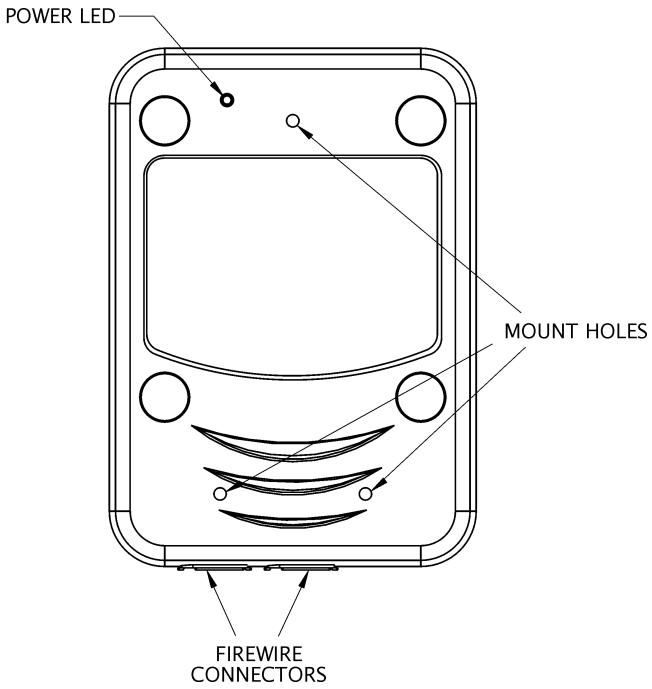

Figure 2.3 Camera Features, Bottom View

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2.2.2 PL-A640 and PL-A660 Camera Dimensions

Note that outlines of the PL-A661 and PL-A662 cameras are shown in these figures; PL-A641 and PL-A642 cameras differ only in the configuration of the C-mount and infra-red (IR) filter. All measurements are ± 0.01 inches (0.3 mm).

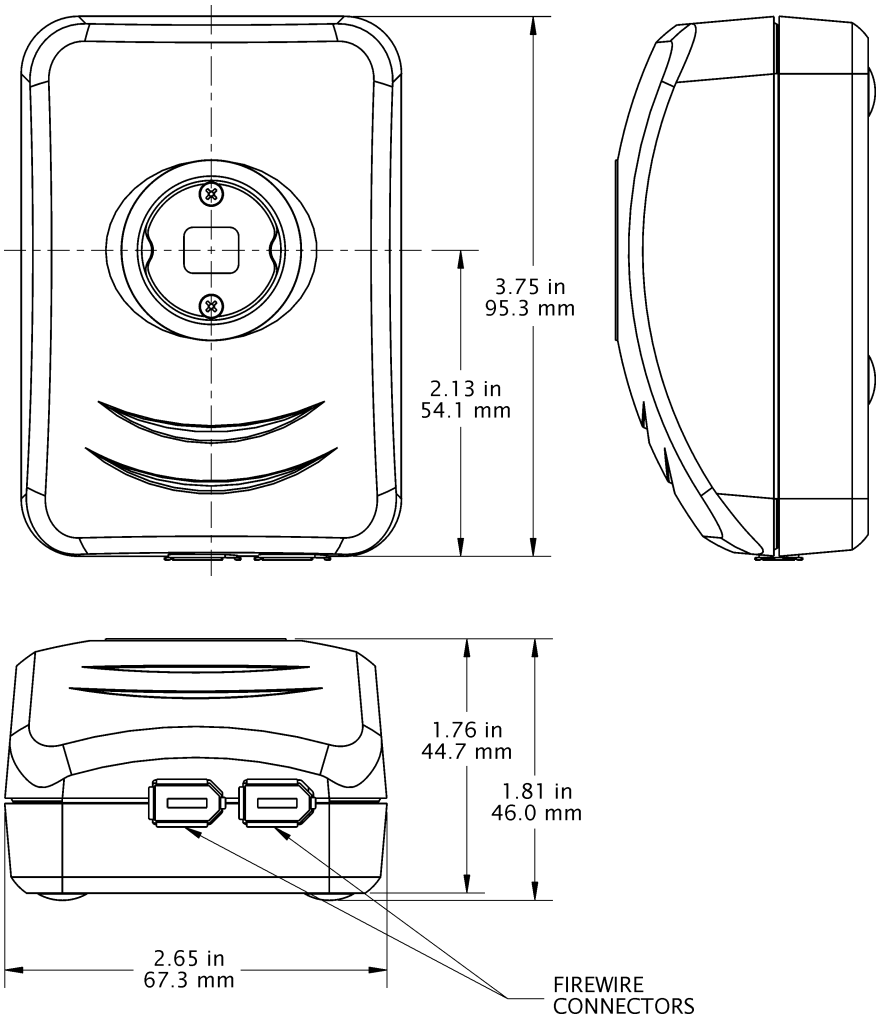

Figure 2.4 Camera, Top, Side and End Views

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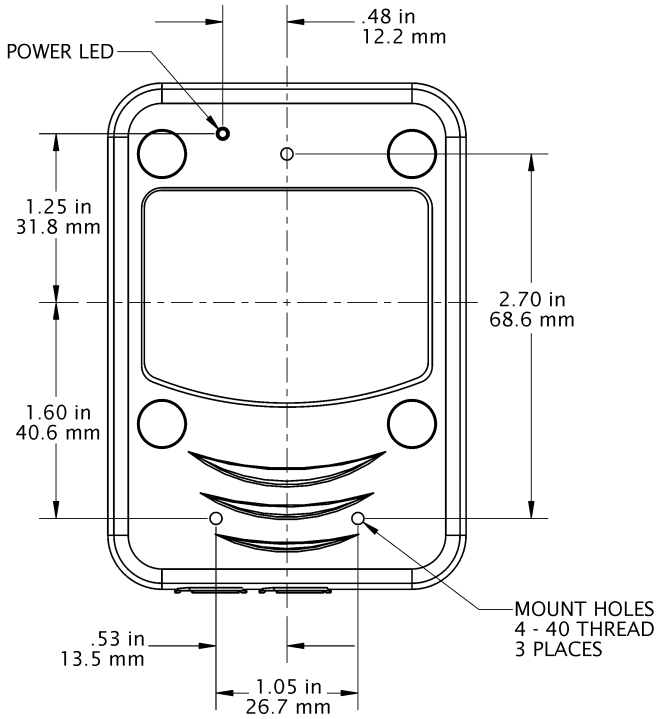

Figure 2.5 Camera, Bottom View (Showing Mount Holes)

2.3 PL-A630 and PL-A650 Series Imaging Module Hardware

2.3.1 Imaging Module Assembly

As shown in Figure 2.6 (on page 10), each PixeLINK imaging module consists of two boards: an Imaging Assembly (the top board) and a FireWire Interface Board (the bottom board, also shown in Figure 2.7 (on page 10). Note that an imaging module might not be exactly as shown, depending on the model.

The camera is fitted with a 1" × 32 tpi standard C-mount lens adapter and equipped with an Enhanced Control header (shown in Figure 2.9, on page 12). Mounting hardware may be attached to the FireWire Interface Board at bottoms of the four spacing posts. A mount suitable for attachment to a tripod is included in each PixeLINK Developer's Kit.

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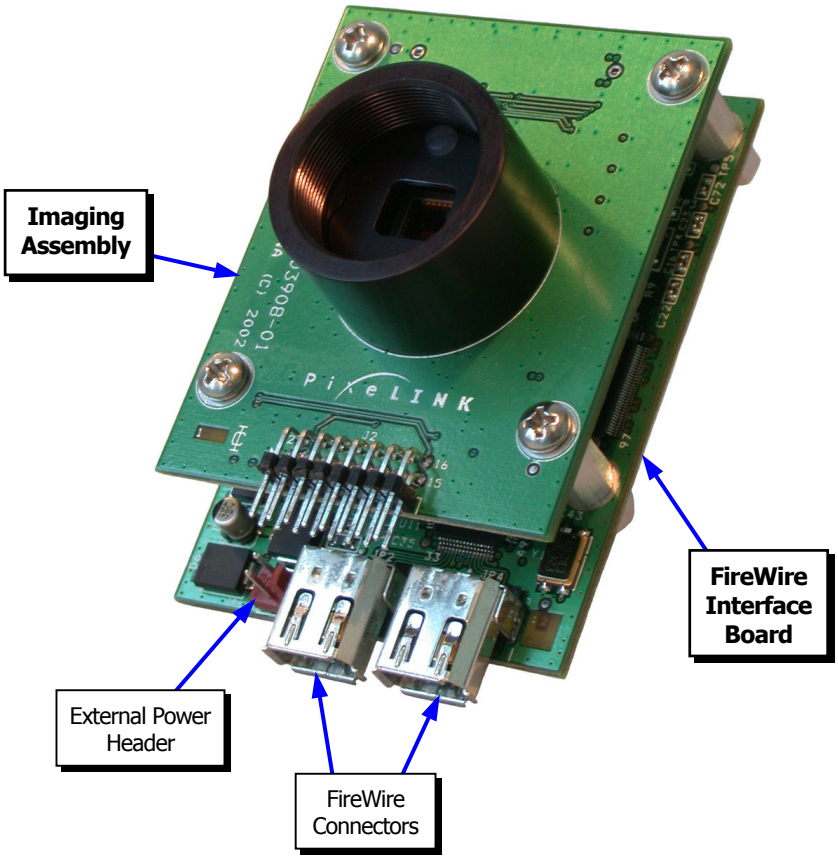

Figure 2.6 PL-A650 Series Imaging Module (PL-A630 Series similar)

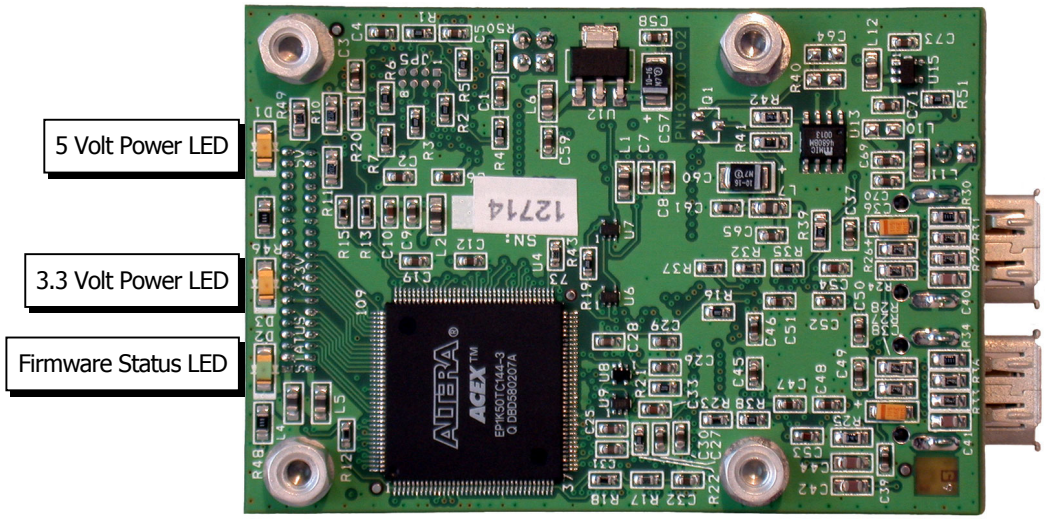

Figure 2.7 FireWire Interface Board (product may not be exactly as shown)

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2.3.2 FireWire Interface Board LEDs

The FireWire Interface Board has three LEDs, described in Table 2.1 (below).

Table 2.1 FireWire Interface Board LEDs

Function	Color	Location in Figure 2.7 (page 10)	Signal Type and Status
Firmware status indicator	Green	Left, bottom	Double pulse—Firmware is running properly
3.3 V Power indicator	Yellow	Left, center	Solid—3.3 V power present
5 V Power indicator	Yellow	Left, top	Solid—5 V power present

2.3.3 Headers

2.3.3.1 External Power Header

As shown in Figure 2.9 (on page 12), an external supply can be attached to the two-pin friction lock external power header. The pinout is shown in Figure 2.8 (below).

The external power source must provide a power of at least 3.0 W for the Imaging Module to operate correctly. Twelve-volt (12 V) operation is recommended, but the voltage may be 8 V to 30 V.

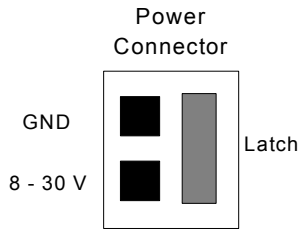

Figure 2.8 External Power Header, Oriented as in Figure 2.9

2.3.3.2 Enhanced Control Header [For use with Microsoft Windows only]

PL-A633, PL-A634, PL-A653 and PL-A654 imaging modules are each equipped with a 16-pin Enhanced Control header. This header—shown in Figure 2.9 (on page 12)—can be connected to external devices such as a flash, trigger or I²C devices. The header pinouts are listed in Table 2.2 (on page 12) for PL-A653 and PL-A654 imaging modules, and in Table 2.3 (on page 13) for PL-A633 and PL-A634 imaging modules.

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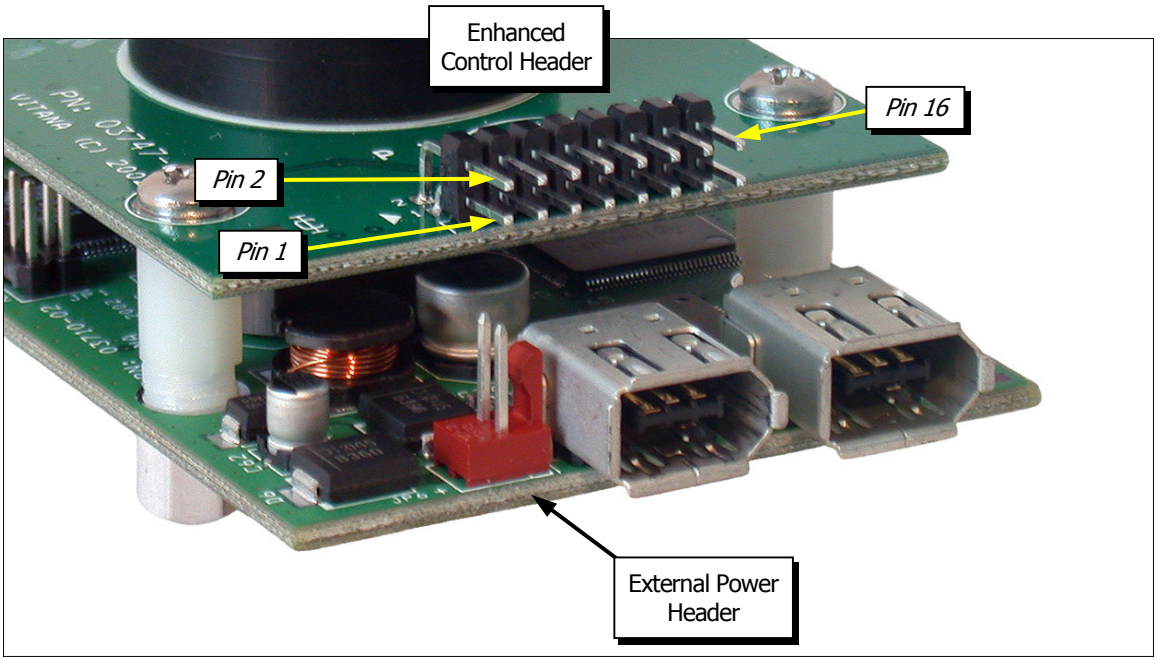

Figure 2.9 Enhanced Control/External Power Headers (may not be exactly as shown)

Table 2.2 PL-A653/PL-A654 Pinout of the Enhanced Control Header

Pin	Pin Name	Function
1	TRIGGER	Trigger—3.3 V or 5 V TTL or CMOS input; high-to-low transition triggers image capture. Refer to PixeLINK API function *PimMegaReturnFrameAfterTrigger*.
2	GND	Ground
3	/RESET	Reset—5 V HCMOS signal output low for about 200 milliseconds at power-up to reset the imaging module.
4	GND	Ground
5	GP1	General purpose output—5 V HCMOS output. Refer to PixeLINK API functions *PimMegaGetGpo* and *PimMegaSetGpo*.
6	GND	Ground
7	FLASH	External flash—5 VHCMOS output; active high pulse. Refer to PixeLINK API functions *PimMegaCaptureFrameToBitmap* and *PimMegaReturnStillFrame*.
8	GND	Ground
9	SHUTTER	Shutter control device—5 V HCMOS output; active high pulse. Refer to the PixeLINK API functions *PimMegaCaptureFrameToBitmap* and *PimMegaReturnStillFrame*.
10	GND	Ground
11	GP2	General purpose output—5 V HCMOS output. Refer to the PixeLINK API functions *PimMegaGetGpo* and *PimMegaSetGpo*.
12	GND	Ground
13	VSYNC	Vertical synchronization—5 V HCMOS output; active high.
14	GND	Ground
15	SCL	I²C interface clock —5 V HCMOS buffered output.
16	SDA	I²C interface data—3.3 V HCMOS level unbuffered bi-directional signal.

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Table 2.3 PL-A633/PL-A634 Pinout of the Enhanced Control Header

Pin	Pin Name	Function
1	Trigger	Trigger—5 V (TTL) input, 10 ms pulse; active low. Refer to PixeLINK API function *PimMegaReturnFrameAfterTrigger*.
2	GND	Ground
3	Reset/	Reset—TTL output; active low. Output is the Board-Level Camera reset signal to the external device.
4	GND	Ground
5	GP1	General purpose output—TTL output. Refer to PixeLINK API functions *PimMegaGetGpo* and *PimMegaSetGpo*.
6	GND	Ground
7	Flash	External flash—TTL output, 10 ms pulse; active high. Refer to PixeLINK API functions *PimMegaCaptureFrameToBitmap* and *PimMegaReturnStillFrame*.
8	GND	Ground
9	SHUTTER	Shutter control device—TTL output; active high. Refer to PixeLINK API functions *PimMegaCaptureFrameToBitmap* and *PimMegaReturnStillFrame*.
10	GND	Ground
11	GP2	General purpose output—TTL output. Refer to PixeLINK API functions *PimMegaGetGpo* and *PimMegaSetGpo*.
12	GND	Ground
13	Vsynch/	Vertical synchronization—TTL output. Image vertical synchronization.
14	GND	Ground
15	I2C Clock	I²C interface clock —TTL output.
16	I2C Data	I²C interface data—TTL level bi-directional.

2.3.4 PL-A650 Series Imaging Module Dimensions

Dimensions of the PL-A650 Series imaging modules (PL-A653 and PL-A654) are shown in Figures 2.10–2.12 (pages 13–14). All measurements are ± 0.005 inches (0.15 mm).

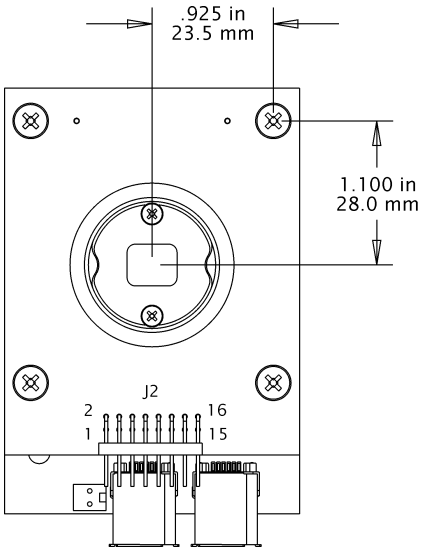

Figure 2.10 PL-A650 Series Imaging Module, Top View

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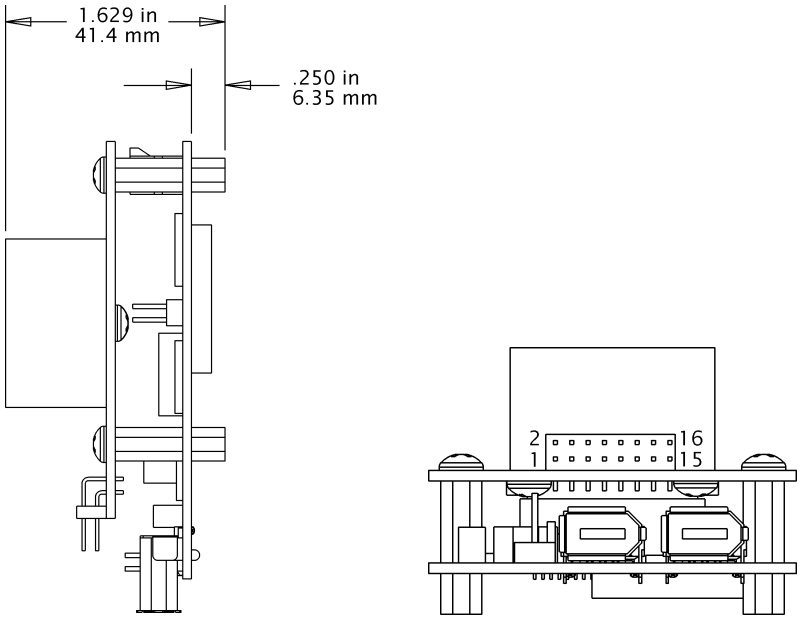

Figure 2.11 PL-A650 Series Imaging Module, Side View and End View

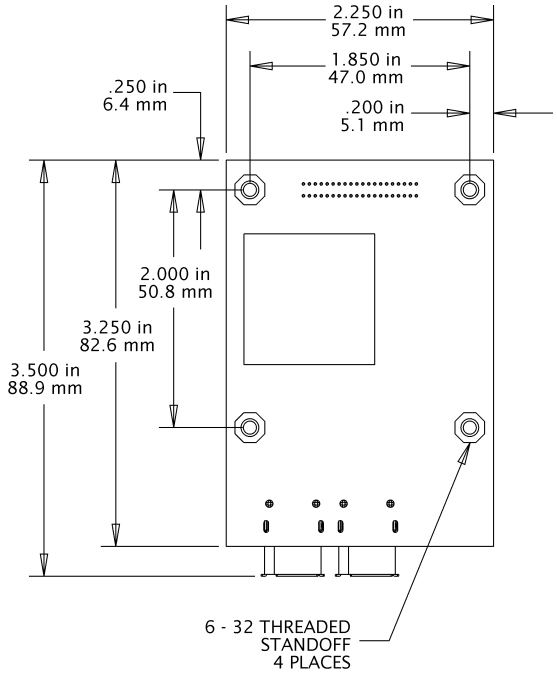

Figure 2.12 PL-A650 Series Imaging Module, Bottom View, Showing Mount Holes

2.3.5 PL-A630 Series Imaging Module Dimensions

For dimensions of the PL-A630 Series Imaging Modules, please contact PixeLINK support. (See page 25 for contact information.)

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2.4 FireWire Connectors and Multiple Cameras

Each PixeLINK camera has two FireWire connectors (ports), allowing several devices to be daisy-chained. The connectors are identical and either may be used to connect to the computer. The other can be used to connect to other FireWire devices.

The number of cameras that may be managed simultaneously depends on the total bandwidth and may be limited by power availability (see Section 2.6, below) and the processing capabilities of the host computer.

The FireWire bus requires that the sum of the packet sizes of the attached cameras be less than 4800. Packet sizes for cameras operating with 640 × 480 and 1024 × 1280 subwindows are given in Table 2.4 (below).

Table 2.4 Packet Sizes

Clock Frequency (MHz)	Subwindow Size	
	640 × 480	1024 × 1280
4	640	1280
6	1280	1280
8	1280	1280
12	1920	2560
16	3200	2560
24	3840	2560

Example: Based on the FireWire bus only, what is the largest number of cameras that can be managed simultaneously if each one operates with 640 × 480 subwindow and an 8 MHz clock frequency?

Solution: The FireWire packet limit is 4800. From Table 2.4 (above), the packet size for a 640 × 480 subwindow at 8 MHz is 1280.

$$\frac{\mathbf{4800}}{\mathbf{1280}} = \mathbf{3.75}$$

Therefore, no more than three cameras can be managed simultaneously at 640 × 480 and 8 MHz.

To confirm:

The total packet size for four cameras is 4 × 1280 = 5120, which exceeds the FireWire packet limit. The total packet size for three cameras is 3 × 1280 = 3840, which is less than the limit.

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2.5 Attaching Lenses and Tripods

The camera can be fitted with a standard C-mount lens or attached to a microscope with a C-mount threading. Simply attach the lens or connect to the microscope using the threaded lens mount indicated in Figure 2.5 on page 9.

The back of the camera has three 4–40 screw holes for the attachment of a mounting fixture such as a tripod. The imaging module can be mounting using the four standard standoffs attached to the Interface Board.

PixeLINK offers custom mounting fixtures for attaching a tripod with a standard ¼–20 screw threading at a 90° angle to the Camera. The tripod mounts are specific to the type of camera.

Table 2.5 Tripod Mount Selection Table.

For this camera …	Use this tripod mount:
PL-A641, PL-642 PL-A661, PL-662	PL-640/660-CAMERA 1/4-20 MOUNT
PL-A633, PL-634 PL-A653, PL-654	PL-MODULE 1/4-20 MOUNT

For more information, contact your PixeLINK vendor or visit the PixeLINK Web site at http://www.pixelink.com/.

2.6 Power

The computer's FireWire bus can supply power to the camera if the host computer has a six-pin FireWire connector and the total power demand on the bus does not exceed the bus capacity. Some systems—such as laptop computers or those with several FireWire devices daisy-chained—require an external 12 V supply to power the camera.

An external power supply can be connected to the FireWire bus. Imaging modules are capable of having an external power supply attached directly to a power header (see Section 2.3.3.1, on page 11).

2.7 IR Filter

Each camera (color and monochrome) is fitted with an integrated infra-red (IR) filter over the image sensor. This filter also acts as a protective cover over the image sensor. The filter may be removed, but doing so increases the likelihood of contaminating the image sensor. **Because of the risk of damage to the sensor, only the manufacturer should perform modifications to the camera fittings.**

The IR filter is held in place by the camera's C-mount (Figure 2.13, on page 17).

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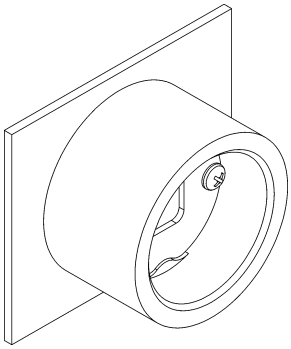

Figure 2.13 Camera C-Mount (PL-A650 and PL-A660 Series shown)

To remove the IR filter:

1. Ensure that the FireWire cable is disconnected from the camera. Remove the lens or other C-mount attachment.
2. Remove the screws holding the IR filter clamp in place (see Figure 2.14, below).

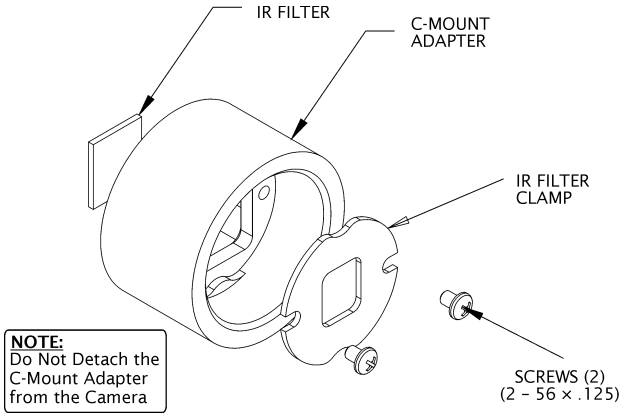

Figure 2.14 Camera C-Mount, Exploded View (PL-A650 and PL-A660 Series shown)

3. Using a pair of fine-point tweezers, carefully lift out the IR Filter Clamp.
4. Place a lint-free cloth over the C-mount. Slowly tip the camera until the IR filter lands gently in the cloth.
5. Replace the IR filter clamp and screws.
6. Reattach the lens or other C-mount attachment and reconnect the FireWire cable.

Minor Cleaning of the IR Filter

1. Carefully apply puffs of dry, compressed air to move particles off the center of the glass.
2. Remove oils with a swab moistened with reagent-grade isopropyl alcohol. The swab should be damp but not dripping. **Do not use acetone to clean the IR filter**.

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3

Host Software Overview (Microsoft Windows)

3.1 Overview

Overview of Figure 3.1

- User Application: Provides a custom control interface for the camera
- PixeLINK API (PimMegaApi.dll): PixeLINK software designed for the development of custom cameras applications
- DirectShow: Microsoft software that can be used to develop custom camera applications
- Stream Class Driver: Provides a bridge between core PixeLINK camera software and DirectShow
- FireWire Minidriver: Core PixeLINK software for controlling the camera and video stream via FireWire
- FireWire Bus Driver: Manages the information sent via FireWire
- OHCI FireWire Driver and Firmware: Adapt the host interface to work with FireWire
- PixeLINK Camera: Receives commands and sends video data via FireWire

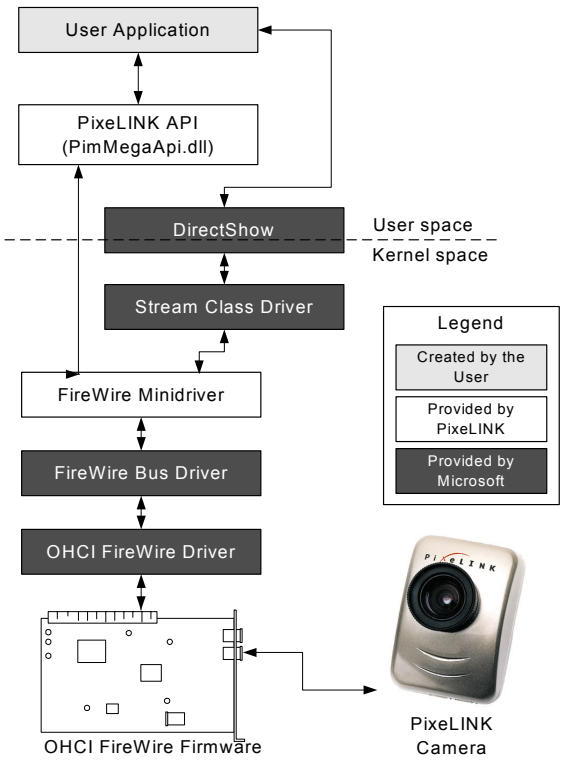

Figure 3.1 Host Software Architecture

The PixeLINK camera software consists of two types of software: the embedded executable software that runs on the camera—that is, the firmware—and the host software that runs on the Windows system. This section focuses on the host software and its interaction with the embedded executable software.

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An application such as *PixeLINK Capture* (described in the PixeLINK Camera User's Manual) can control the camera through a stack of software modules, drivers and libraries. Some of this software is accessible to the user; the rest is in the kernel. The relationship between user space and kernel space is illustrated in Figure 3.1 (on page 18).

3.2 Software Components

The function of each software component shown in Figure 3.1 (on page 18) is listed below.

- **User Application:** A custom application, based on the PixeLINK API or DirectShow (both described below), controls the camera, retrieves data from it, and displays or stores the data. This application can be written by the user, provided by PixeLINK or incorporated into third-party software (in cooperation with PixeLINK).
- **PixeLINK API (PimMegaApi.dll):** This standard library provides the application with functions to control the camera and the video stream. The PixeLINK API (described in the PixeLINK Camera API Reference) is used to create custom applications to access imaging data directly from the FireWire Minidriver. The imaging data can be formatted for screen display or for further processing or analysis.
- **DirectShow:** Microsoft DirectShow multimedia software implements a specific hardware and software standard for image streaming and is part of the DirectX suite of multimedia APIs provided my Microsoft. DirectShow software can be used, as an alternative to the PixeLINK API, to integrate control of the camera with that of other multimedia hardware and software, enhancing the functionality of the camera.

  Microsoft offers several DirectShow filters for functions such as:
  - Data compression and decompression
  - Data coding and decoding
  - Color conversion
  - Rendering (DirectDraw)

  For more information about DirectShow and DirectX, visit the DirectX Web site at http://www.microsoft.com/windows/directx/.
- **Stream Class Driver:** This driver allows the camera to work with DirectShow by enabling the transfer of data between DirectShow and the PixeLINK FireWire Minidriver.
- **FireWire Minidriver:** This PixeLINK software is the interface between the FireWire bus and either the PixeLINK API or the Direct Show/Stream Class Driver. The FireWire Minidriver is responsible for:
  - Detecting the features supported by the camera and reporting them to the PixeLINK API or the Direct Show/Stream Class Driver;
  - Receiving streams of data from the FireWire Bus Driver and transmitting them in the appropriate format to the PixeLINK API or to the Stream Class Driver;

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- Handling FireWire bus resets and device removal (e.g., when the cable is unplugged from the camera)

The PixeLINK FireWire mini-driver exports the following functionality to the DirectShow:

- Exposure
- Gain
- Pan/Tilt

- **FireWire Bus Driver:** This component performs serial bus management for the OHCI FireWire Firmware. That is, it manages the content (video data and camera control signals) transmitted over the FireWire cable between the camera and the host computer. The FireWire Bus Driver can act as the cycle master, isochronous resource manager and bus manager.
- **OHCI FireWire Driver:** This component instructs the OHCI FireWire Firmware to send and receive packets of information via the FireWire cable.
- **OHCI FireWire Firmware:** This generic firmware is programmed on an adapter card that enables the host computer to work with FireWire. An adapter card designed for desktop computers is included in selected PixeLINK camera kits. If the host desktop computer already has a FireWire port available, the card is not necessary. Laptop computers require a preinstalled FireWire port or CardBus slot. Refer to your PixeLINK Camera User's Manual for more information.
- **PixeLINK Camera:** The camera is linked to the rest of the system via the FireWire cable. The cable carries control signals and power to the camera and the video stream to the host computer.

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4

Exposure Methods

"Video Mode" and "Still Mode" refer to imager exposure methods. While all of the PL-A630 to PL-A660 Series cameras can operate in either mode, only cameras equipped with Enhanced Control headers can be connected to external flash and shutter control devices (preferable for Still Mode).

PL-A650 and PL-A660 Series cameras use a rolling shutter in both Video Mode and Still Mode. Earlier cameras use a rolling shutter in Video Mode and simultaneous exposure in Still Mode.

4.1 Video Mode Exposure

In video mode, exposure of the image sensor is controlled by a virtual window that moves from the top to the bottom of the subwindow and then rolls up to the top of the subwindow for the next image frame. This virtual window is the same width as the subwindow and has a height proportional to the exposure time. This is similar to a **rolling shutter** in conventional photography.

Rows are removed from and added to the virtual window as it moves. The virtual window moves one row at a time, when the fully exposed row of pixels on its trailing edge is transferred to the image frame and an unexposed row is added to its leading edge. When the leading edge reaches the bottom of the subwindow, the virtual window rolls to the top of the subwindow to start exposing rows for the next frame. Thus, at any given time, the level of exposure of a particular row depends the amount of time since it was added to the virtual window.

As each trailing edge row is transferred, an image frame is built from top to bottom. Since all rows in a finished frame are exposed equally and rows are transferred continually, this strategy is appropriate for still image capture in ambient lighting conditions, video capture and interactive image control.

4.2 Still Mode Exposure

Note:

External flash and shutter control devices can be connected to cameras with Enhanced Control headers only (PL-A633, PL-A634, PL-A653, PL-A654).

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4.2.1 Using PL-A650 and PL-A660 Series Cameras in Still Mode

PL-A650 and PL-A660 Series cameras return a still frame using the same rolling shutter technique used for a video frame. These cameras therefore respond better than earlier cameras to still image capture under ambient light by providing consistent exposures throughout the frame. However, if used with synchronized flash, a slightly different approach must be employed. An exposure time of sufficient duration to integrate all rows in the active region of interest must be used, with the flash firing between the time of all rows being simultaneously exposed and prior to the start of data read-out.

To determine the exposure and flash timing, consider the camera clock rate, size of the region of interest (columns and rows), and decimation. The simplest way to do so is to use *PixeLINK Capture* or the *PL-A6xx Application* and set the appropriate subwindow size. With the video preview playing, observe the measured frame rate. Take the inverse of this number to get the minimum exposure time required for a still-image capture with an external flash. Use this number as a starting point to determine the proper exposure time and flash delay for your application. For example, with the camera operating at 12 MHz, the full-resolution frame rate is 11.7 fps. The minimum still frame exposure is then (1/11.7) = 85.5 ms. In our tests, we chose an exposure time of 120 ms to add a generous buffer. We chose a flash delay of 90 ms as a starting point, and, after some experimentation, we discovered that having the flash fire 110 ms after the trigger would produce good results.

4.2.2 Using PL-A630 and PL-A640 Series Cameras in Still Mode

When in Still Mode, the entire subwindow of a PL-A630 or PL-A640 Series camera is exposed simultaneously for a specified exposure time, rather than using the row-by-row rolling shutter strategy of Video Mode. Exposure times can range from sub-milliseconds to about half a second. However, the build-up of dark current noise will be noticeable in the output image for exposure times greater than 100 ms.

After the specified exposure time has elapsed, the image sensor is read out from top to bottom at maximum speed. So, under ambient light conditions, the bottom rows of the image sensor would continue to be exposed for the length of time required for read-out. This results in the image being over-exposed towards the bottom of the image. Thus, it is usually best to use Still Mode under controlled lighting conditions.

For Enhanced Control cameras (PL-A633 and PL-A634), one method to control the lighting conditions is to use the built-in capability to synchronize a flash pulse during the still frame capture under dark conditions. (In the PixeLINK Camera API, refer to API functions *PimMegaReturnFrameAfterTrigger* and *PimMegaReturnStillFrame*.) Where dark conditions are not possible and ambient light cannot be controlled, an electronically triggered shutter can be used to cut off the ambient light at the end of the specified exposure time. With the shutter closed, the read out from the image sensor can proceed without any further influence from ambient light.

The PixeLINK Camera API functions also provide the ability to control a shutter, synchronized with a still frame capture. Exposure times, flash pulse timing, and shutter timing signals can be specified to 1/10 of a millisecond.

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4.2.3 Using External Triggering, Flash and Shutter Signals

Note:

External flash and shutter control devices can be connected to cameras with Enhanced Control headers only (PL-A633, PL-A634, PL-A653, PL-A654).

PixeLINK cameras with Enhanced Control headers can receive external triggering signals and can issue flash and shutter timing controls. These signals are controlled by the PixeLINK API functions *PimMegaReturnFrameAfterTrigger* and *PimMegaReturnStillFrame*.

- *PimMegaReturnFrameAfterTrigger* puts the camera into a trigger mode and begins to capture a still image no more than 90 µs after an external trigger signal is detected.
- *PimMegaReturnStillFrame* returns a still frame immediately after being called and can be used as a software trigger. However, due to operating system and interface delays, the minimal response time will be 15 ms with possible delays greater than 60 ms depending on the system configuration.

Flash and shutter timing controls provided to the PixeLINK API functions represent the delay in milliseconds following the trigger signal. The delays are accurate to one decimal place (0.1 ms). It is important to note that negative numbers are allowed. In the case where a negative delay is used with an external trigger, the timing signals occur in order. For example, with a flash delay of –15 ms and shutter delay of –5 ms, on receipt of the trigger signal the flash signal will be fired immediately, followed 10 ms later by the shutter signal. 5 ms after the shutter, the camera will start the exposure.

The shutter timing signals also include a shutter close delay to close an external shutter following an exposure.

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Appendix A. Glossary

1394 Short for the IEEE 1394 digital bus protocol (also known as FireWire, a trademark of Apple Computer, Inc.)

API Application Programming Interface

DLL Dynamic Link Library

FireWire Apple Computer's trademark for the IEEE 1394 digital bus protocol

fps Frames Per Second

GPO General Purpose Output

I²C Inter-IC (also known as I2C), a bus standard invented by Philips

IEEE Institute of Electrical and Electronics Engineers

MB Megabyte

MHz Megahertz

OHCI Open Host Controller Interface

PC Personal Computer

PCI Peripheral Component Interconnect

preview window The window used to display video images on the screen. The default size is the same number of rows and columns as in the image.

QuickTime Apple Computer multimedia software

RAM Random Access Memory

ROM Read-Only Memory

sensor The Camera's image sensing chip

subwindow The area exposed on the imager (not a window defined for viewing the image on the screen)

TWAIN An image capture standard typically used as an interface between image processing software and a camera or scanner

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Technical Support

Tech Notes

Tech Notes on a variety of topics are available on the PixeLINK Support Site, at **http://support.pixelink.com/**.

Download the Latest Software and Firmware

We recommend that you check http://support.pixelink.com/ regularly for the latest versions of your PixeLINK software and firmware.

Technical Questions

Please follow these steps before contacting our technical support team:

- Review the relevant sections of the documentation.
- Check the PixeLINK Support Site for
  - new software and firmware;
  - applicable Tech Notes.
- Carefully document the problem you are experiencing, noting any warning or error messages that may appear during operation.
- Have your camera's serial number and other identifying information at hand. The serial number can be found on the camera, on the "About" screen in *PixeLINK Capture,* or by using the PixeLINK Camera API function *PimMegaGetHardwareVersion.*

PixeLINK Customer Support

Email: support@pixelink.com
PixeLINK Support Site: http://support.pixelink.com/
PixeLINK Main Site: http://www.pixelink.com/

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